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## (54) Apparatus for the controlled withdrawal and delivery of volumetrically metered liquids

(57) Apparatus for the controlled withdrawal and delivery of volumetrically metered liquids of a type comprising a support structure able to receive a first series of vessels or bottles which contain substances in a liquid phase, and a second series of vessels or glasses able to receive one or more said substances in preset doses, means being provided for withdrawing and feeding said

substances in preset doses and able to withdraw said substances individually from said bottles and discharge them into said glasses, apparatus characterized in that said withdrawal and delivery means comprise a series of single withdrawal and delivery members (7) able to be positioned in correspondence of each of said bottles and resolutely matchable with an actuation and driving head (6).

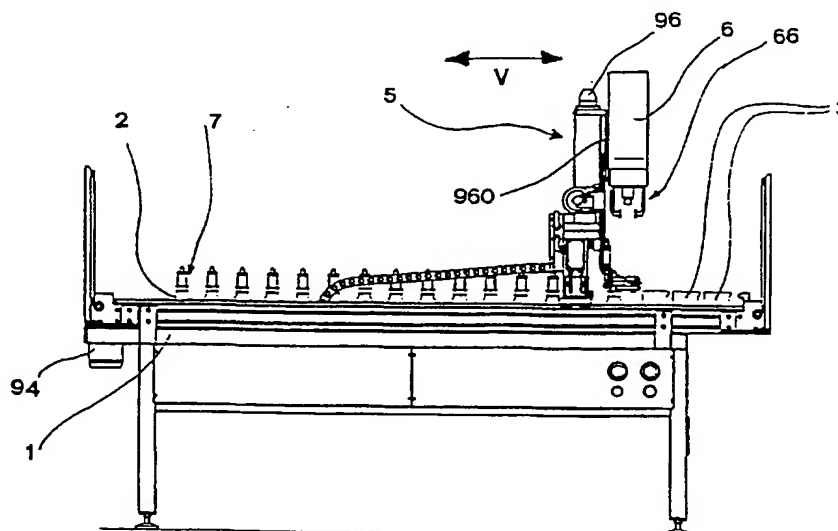


Fig. 1

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1

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2

**Description**

[0001] The present invention refers to an apparatus for the controlled withdrawal and delivery of volumetrically metered liquids.

[0002] Existing apparatus for volumetric metering, especially of the type used in the preparation of dye solutions for dyeing textile materials, comprise essentially a structure with a platform more vessels or "bottles" disposed thereon which contain the solutions, each vessel containing one solution corresponding to a predetermined colour and being located in a fixed and preset position of the platform. Provided in a separate station of the same platform, in correspondence of fixed and preset positions, are vessels or "glasses" intended to receive the solutions drawn from the bottles in preset doses. The withdrawal and metering of the solutions are operated by means of a syringe or "pipette" movable on the platform between the bottles containing the solutions to be drawn therefrom and the glasses which receive them in preset doses. An electronic processor or computer controls the movements of the pipette between the various sites on the platform.

[0003] In order to use the same syringe upon the removal and metering of different solutions, a washing is to be carried out each time by means of a suitable solvent to avoid detrimental solutions contaminations. Such an apparatus is disclosed in the document EP-A-0,602,737.

[0004] A drawback stemming from the use of an apparatus of the type above described is the fact that whenever the syringe is washed, there is a loss of residual liquid, that is, the one exceeding the dose to be taken into the glasses, which residue is ejected together with the solvent and collected in a drain duct for subsequent disposal thereof along with other elements.

[0005] A further drawback lies in the general slowing down of the operations due to the time and care required to carry out a proper washing of the syringe. Besides, it is not to be fully excluded the possibility that the solutions will be contaminated all the same, since, subsequently to the washing, the syringe chamber may still exhibit some amounts of residual solvent.

[0006] It should also be noted that by using this type of apparatus for the volumetric metering of liquids such as essence and perfume solutions, each washing requires a huge quantity of solvent, or alcoholic products, which are more expensive than water. In this industrial sector, the problem of possible contamination of different solutions to be treated is in fact particularly felt, and such contaminations may bring about damages which are more serious than in the case of preparing dye solutions for dyeing textile materials.

[0007] The object of the present invention is to overcome the said drawbacks.

[0008] This result has been achieved, according to the invention, by adopting the idea of making an apparatus having the features disclosed in claim 1. Further

characteristics being set forth in the depending claims.

[0009] The advantages deriving from the present invention lie essentially in the fact that it is possible to completely eliminate the need of carrying out the washing of the syringes, which implies a significant reduction in the operational times and, thereby, a corresponding increase of the production capacity of the apparatus and the total elimination of the risk of solutions contamination; that an apparatus according to the invention is easy to make, cost-effective and reliable even after a prolonged service life; that it is possible to treat, that is, withdraw and meter, with maximum accuracy and without any possibility of contamination, liquids of any type, such as dyeing solutions for dyeing operation and solutions for the perfume or pharmaceutical industry.

[0010] These and other advantages and characteristics of the invention will be best understood by anyone skilled in the art from a reading of the following description in conjunction with the attached drawings given as a practical exemplification of the invention, but not to be considered in a limitative sense, wherein:

- Figs. 1,2 are respectively, a side view and a top view of a feasible embodiment of an apparatus according to the invention;
- Figs. 3a, 3b, 3c and 3d show in schematic side view sequential stages for the withdrawal of a liquid from a storage vessel or bottle.

[0011] With reference to the accompanying drawings which, as set forth above, refer to one of possible embodiments, the present invention concerns an apparatus for the controlled withdrawal and delivery of volumetrically metered liquids. The apparatus comprises a support structure (1) defining a plane on which a series of first vessels (2) and a series of second vessels (3) may be disposed. The first vessels, also referred to as bottles (2) in this description, contain substances in liquid phase to be suitably combined by introducing them into the second vessels (3) (indicated as glasses hereinafter). In order to transfer the substances held in the bottles (2) into the glasses (3), withdrawal means are provided comprising at least a bridge (4) movable in two directions on the structure (1), according to the longitudinal development of the same structure, under control of relevant motive members (94) for example of electrical type, with a rod (940) and transmission belts (941). The bridge element (4) supports a movable equipment (5) able to move along the bridge element (4) along a direction (F) transverse to the longitudinal development of the structure (1) and, therefore, orthogonally to the above said direction (V), under control of a motive member (95) of electrical type, for example, with relevant transmission annular belt (950). In practice, the movable equipment is made to move on the plane of the structure (1) along the two dimensions thereof. Moreover, in correspondence of the movable equipment (5) there is provided a clamping head (6), also referred to as moving

and operating head (6), associated to relevant motive members (96), of electrical type for example, said head being vertically movable (in a direction indicated by z in Figs. 3b and 3d) onto a corresponding straight guide (960), close to and away from the plane of the structure (1) on which the vessels (2, 3) are disposed. The clamping head (6) has two arms (66) able to be moved under control close to and away from each other, for example in the direction indicated by (P) in Fig. 3a, so as to define a clamping member for a series of individual withdrawal and delivery members consisting, for example, of syringes (7) provided in correspondence of each bottle (2). The individual withdrawal and delivery members may also consist of pipettes or similar elements.

Under a rest condition, each syringe (7) is inserted into the access aperture (8) of the relevant bottle (2), and the relevant needle (77) is dipped into the substance held in the same bottle. The syringe (7) has a peripheral portion or collar of larger cross-section (78) and of such dimensions as to completely occlude the opening of the bottle (2). This feature allows the bottle (2) to be tight-sealed thereby preventing any possible leak due to evaporation of the substances held therein.

[0012] Upon the withdrawal of the substance contained in a given bottle, the movable equipment (5) is brought in correspondence of the selected bottle (2) and the clamping head (6) is moved downwards as illustrated in Figs. 3a and 3b. Above its own plunger (70), the syringe (7) has a moving portion (79) provided with a thread that defines a screw nut on which suitable screw means (60) are made to act via a corresponding stepping motor (9). The action of the screw means (60) drives the moving portion (79) and the plunger (70) solid thereto into a vertical displacement; in this way, it is possible either to fill in or empty out the syringe (7) in correspondence of an upwards or downwards movement, as well as to withdraw or feed a predetermined dose. As the withdrawal operations go on, according to what is illustrated in Figs. 3c and 3d, the screw means (60) are operated to fill the syringe (7) with the preset dose of liquid contained in the selected bottle. Finally, the clamping head is lifted up in the direction (2) shown by the arrow, and the movable equipment (5) is moved along with the syringe (7) toward the glass (3) which is to receive the removed substance. Once the syringe (7) has been emptied out of its content (that is, after feeding the preset dose), it is brought back to its rest position.

[0013] To operate the means which drive the movable equipment (5) and the clamping head (6), use can be made of a programmable electronic unit (not represented in the figures of the attached drawings) having a memory for storing data relevant to the positions of the bottles (2) and glasses (3) and the values relevant to the preset doses, that is, to the extent of the stroke of plunger (70) of each syringe (7). All the above mentioned motive members are associated to the said programmable unit. The latter, being known per se to those skilled in the art, is not described in greater detail.

## Claims

1. Apparatus for the controlled withdrawal and delivery of volumetrically metered liquids of a type comprising a support structure able to receive a first series of vessels or bottles which contain substances in a liquid phase, and a second series of vessels or glasses able to receive one or more said substances in preset doses, means being provided for withdrawing and feeding said substances in preset doses and able to withdraw said substances individually from said bottles and discharge them into said glasses, apparatus characterized in that said withdrawal and delivery means comprise a series of single withdrawal and delivery members (7) able to be positioned in correspondence of each of said bottles and resolvably matchable with an actuation and driving head (6).
2. Apparatus according to claim 1, characterized in that said individual withdrawal and delivery members (7) are shaped substantially as a syringe.
3. Apparatus according to claims 1 and/or 2, characterized in that said individual withdrawal and delivery members (7) are provided with means (78) for closing said bottles (2).
4. Apparatus according to claim 3, wherein said bottles have each an access aperture, characterized in that said closing means (78) consist of a portion or collar (78) of larger cross-section exhibited by said individual withdrawal and delivery members (7) which is able to define a plug for said aperture (8) of the bottles (2).
5. Apparatus according to claim 2, characterized in that said individual withdrawal and delivery members (7) have a plunger (70) solid to the a threaded portion defining a screw nut (79), said head (6) being provided with screw means (60) complementary to said screw nut (79) and able to move directions said plunger (70) in two directions during the withdrawal and delivery operations.
6. Apparatus according to claim 1, characterized in that said head (6) is provided with two arms (66) able to individually clamp said withdrawal and delivery members (7).

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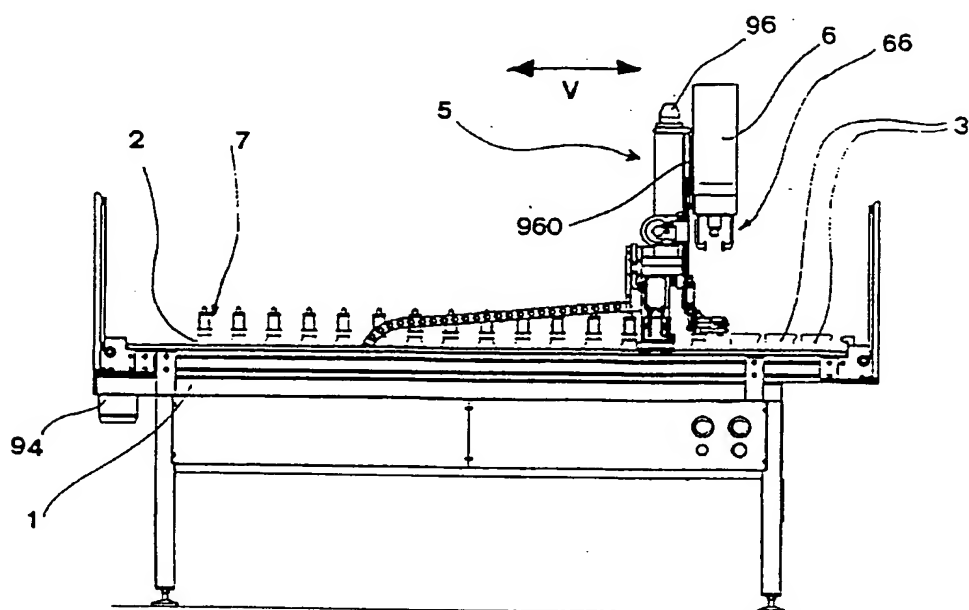


Fig. 1

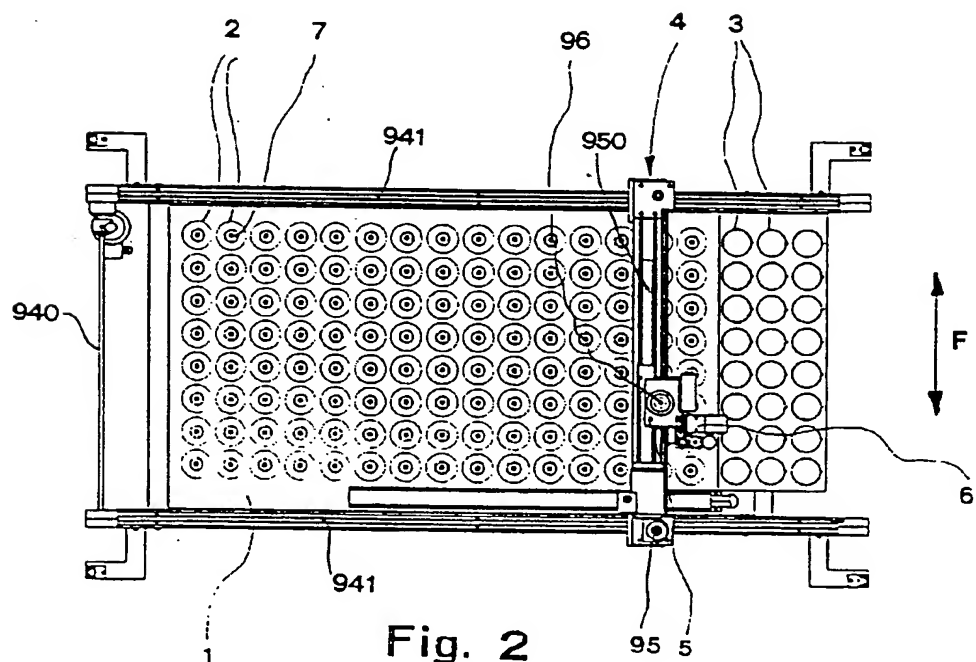


Fig. 2

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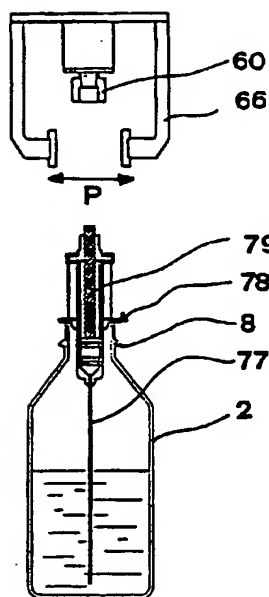


Fig. 3a

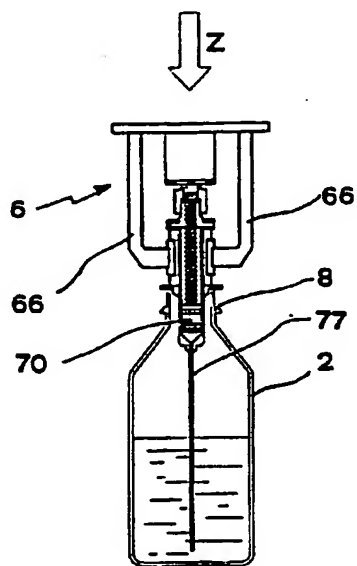


Fig. 3b

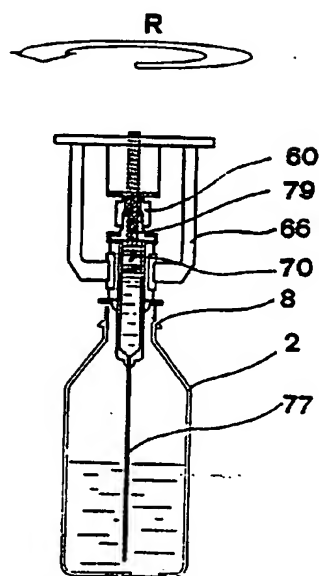


Fig. 3c

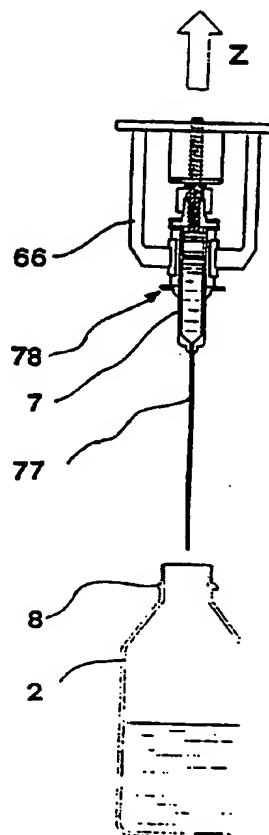


Fig. 3d

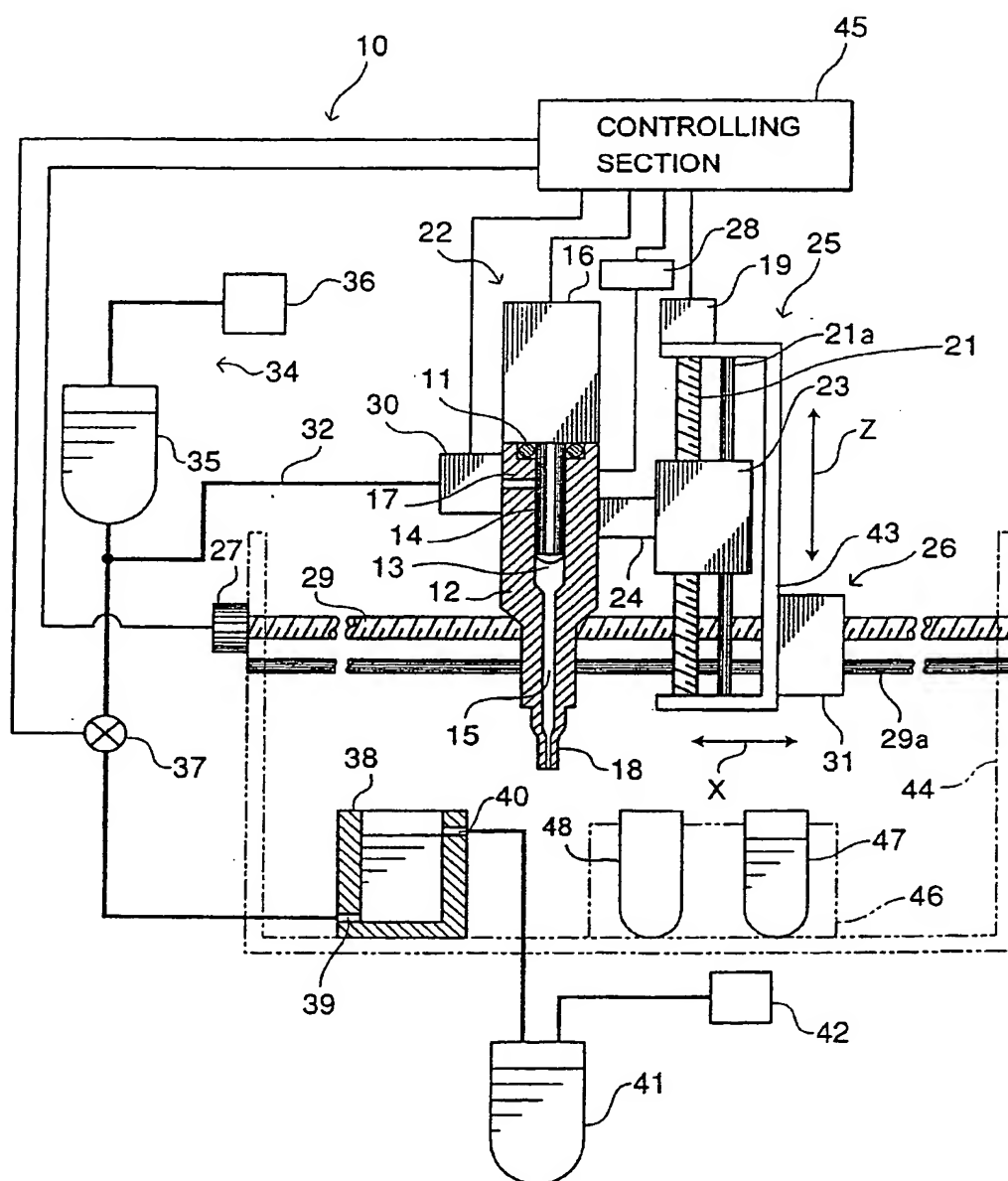


FIG. 2

SPECIFIED VALUE $\mu$ L	RESULTS			
	SUCKED		DISCHARGED	
0.99	mean	1.99	mean	0.81
	SD	0.09	SD	0.06
	CV (%)	4.54	CV (%)	7.74
1.98	mean	2.88	mean	1.85
	SD	0.07	SD	0.05
	CV (%)	2.58	CV (%)	2.70
4.98	mean	6.21	mean	4.60
	SD	0.04	SD	0.08
	CV (%)	0.69	CV (%)	1.71
10.01	mean	11.09	mean	9.72
	SD	0.06	SD	0.07
	CV (%)	0.58	CV (%)	0.73
40.01	mean	40.74	mean	39.55
	SD	0.09	SD	0.10
	CV (%)	0.21	CV (%)	0.26

FIG. 3

SPECIFIED VALUE $\mu$ L	RESULTS			
	SUCKED		DISCHARGED	
0.99	mean	2.46	mean	1.39
	SD	0.09	SD	0.13
	CV (%)	3.49	CV (%)	9.01
1.98	mean	3.43	mean	2.33
	SD	0.06	SD	0.14
	CV (%)	1.75	CV (%)	5.89
4.98	mean	6.19	mean	5.22
	SD	0.09	SD	0.10
	CV (%)	0.69	CV (%)	1.93
10.01	mean	10.95	mean	10.49
	SD	0.12	SD	0.10
	CV (%)	1.06	CV (%)	0.97
40.01	mean	38.81	mean	38.33
	SD	0.05	SD	0.08
	CV (%)	0.13	CV (%)	0.21



FIG. 4

FIG. 5

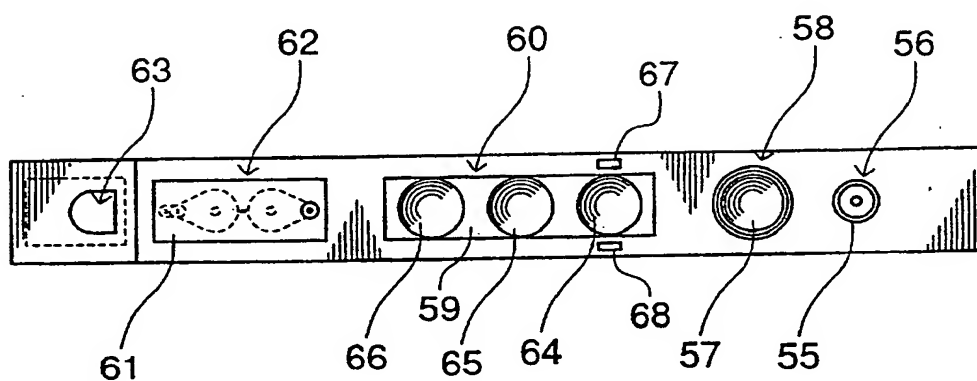


FIG. 6

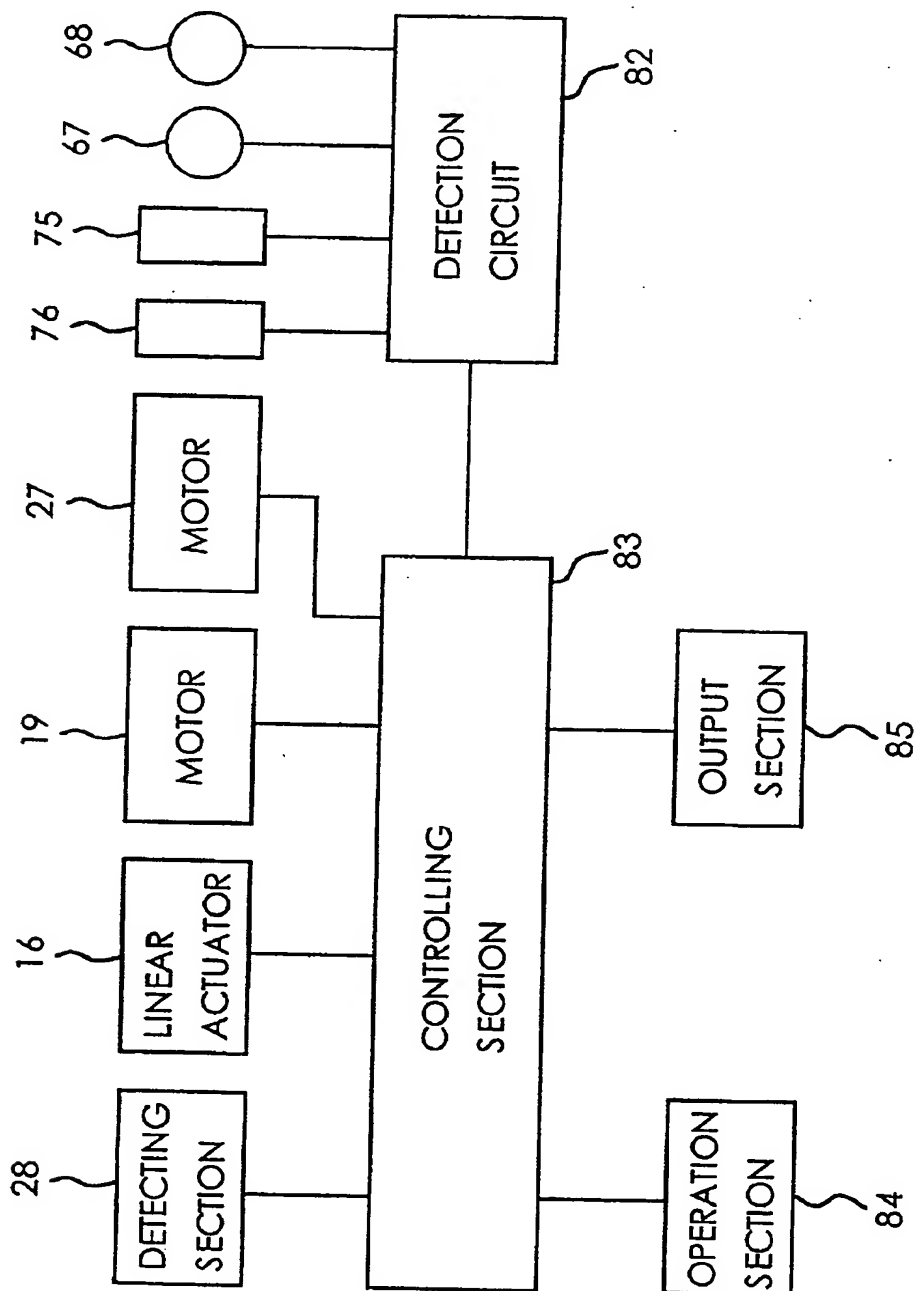


FIG.7

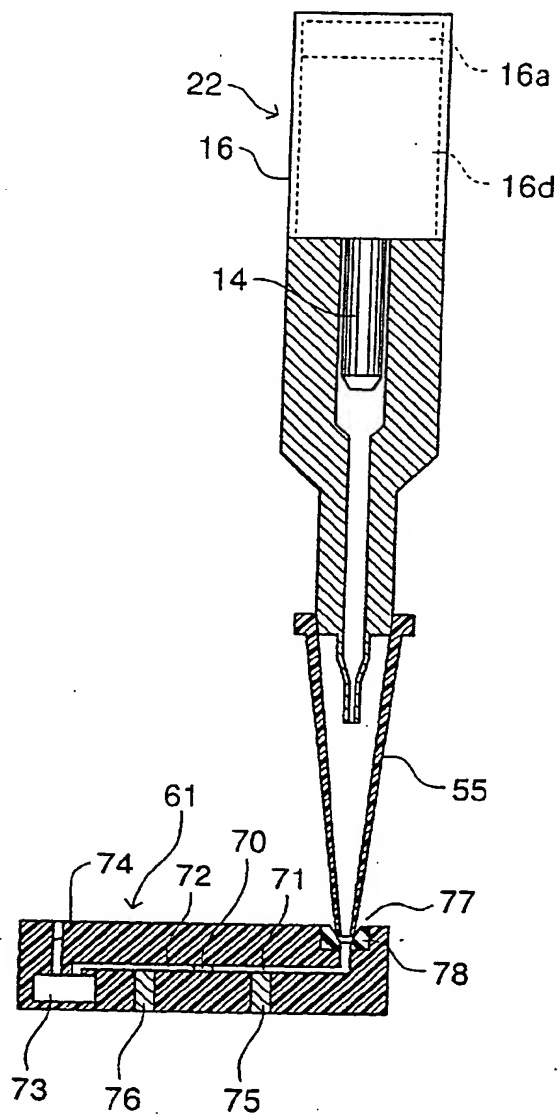


FIG.8

